Technical White Paper

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Data Acquisition with the Cloud and Mobile Devices

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The Internet of Things, or IoT, is on the radar of every business, and the interest is getting bigger. According to Gartner Group, over 4.9 billion connected devices will be in use by the end of 2015, not including smart phones and tablets. The Internet of Things is the way data will be created and collected by the rapid and enormous growth of sensors in the physical environment. This growth will occur in residential, commercial, and industrial settings, in virtually every application from household device asset management to command and control of commercial building automation systems and factory and process automation systems in large facilities.

The concept of "the Cloud" is an outgrowth of the rapidly reducing cost of storage for data, and the huge increase of volume of data from IoT sensors. The Cloud is simply all of the servers and data storage devices to which data can be ported and from which data can be served. Using the Cloud truly makes data easily accessible for residential, commercial, and industrial settings. Thus, combining all systems and applications into one invisible location.

Put together, the IoT and the Cloud make it possible for sensors to be everywhere, for data storage to be anywhere, and, through the use of mobile devices, control and display of data to be anywhere as well. This is what Advantech means when they use the acronym IoT Data A-P-P. It stands for "data Acquisition, data Processing (conditioning) and data Publishing."

Flexible Web Interfaces for Cross Platform and OS Operation

In order for Big Data, the Cloud, and the Internet of Things to function seamlessly, none of them can be dependent on platforms or operating systems. Web interfaces are the most common method of access by nearly all devices. Compared with .NET programmed utilities, or mobile APP, web interfaces are much less limited, exactly because they are platform and operating system independent, and designed to operate cross platform and cross OS seamlessly and easily.

HTML 5

HTML 5 is the core technology markup language of the Internet used for structuring and presenting content for the Web. It has replaced HTML 4, XHTML, and even the semi-proprietary and formerly ubiquitous FLASH as the way data is presented on the Web.

Advantech's WISE IoT modules provide Web interface configuration, with Web pages designed based on the HTML 5 format. Modern browsers, such as Microsoft IE, Google Chrome, Mozilla Firefox or Apple Safari, support HTML 5, and the user can access the WISE Module using any device or platform that supports HTML 5.

Mobile Device as HMI

The generation called Millennials has grown up with mobile devices. Most are smart phone and tablet users using less desk or laptops. More and more, mobile devices are becoming the preferred interface device for the Internet of Things. People are also part of the Internet of Things. Having a device that is small enough to fit in your pocket yet powerful enough to act as a complete HMI or IoT devices is liberating. It will get people out of offices and control rooms and get them where they need to be, in the field or in the process.

People will use mobile devices both to interact with IoT devices and to receive services from the cloud. Advantech's WISE modules have advanced mobile device connectivity. A WISE module can be accessed directly with WLAN connectivity. Detailed information can be shown on the mobile device using the built-in web server.

There are two modes of access. When using a WiFi interface with a smart phone, the user can configure the smart phone to access on of the access points (AP) nearby. The WISE module can have access to the AP first and then the smart phone, which is also accessing the same AP. This lets the AP act as a wireless Ethernet switch for both devices. This is called Infrastructure Mode. When configuring the device or to do module diagnostics, the WISE-4000 series provides another mode called limited AP mode. Users can configure the smart phone or other Ethernet device to access the WISE module directly instead of through an AP. This allows the WISE module to operate as its own AP and the user can find the SSID for the module and connect to it, as if there was a wireless switch. This makes configuration and diagnostics of WISE modules easier and simpler, without the need for an actual infrastructure access point.

Figure 1: Advantech IoT Wireless Modules: WISE-4000 Series

RESTful Web Service

REST, which stands for Representational State Transfer, has become one of the most important technologies for web applications, and, as applications move toward API architectures, it is expected to become even more important. REST is architecture for hypermedia applications, and is primarily used to build web services that are lightweight, maintainable, and scalable. In other words, RESTful web services are designed nearly perfectly for the Internet of Things and have become one of the most popular interfaces in IoT applications from Advantech.

REST is a software architecture style and widely adopted in IoT applications. It is based on Hypertext Transfer Protocol or HTTP an uses verbs like, Get, Post, Put, Delete, etc. for web browsers to get web pages or retrieve data with remote servers. So, data can be polled or even pushed by devices. The data can be retrieved by internet media type like JSON. REST uses uniform identifier (URI) to identify the resource.

Figure 2: RESTful Web API

RESTful web API is more popular for IT programmer than compared with automation user which is using Modbus protocol. It's easier for IT using RESTful web API and it's the most popular interface for the IoT, especially the Cloud.

RESTful web API is based on HTTP, which can support security as HTTPS and works with the WAN for more IoT application and cloud communication. Standard Modbus protocol does not support any security or it can only work on the LAN. Also, Modbus is a polling architecture during communication however, RESTful web API enables not only pulling but also auto-pushing.

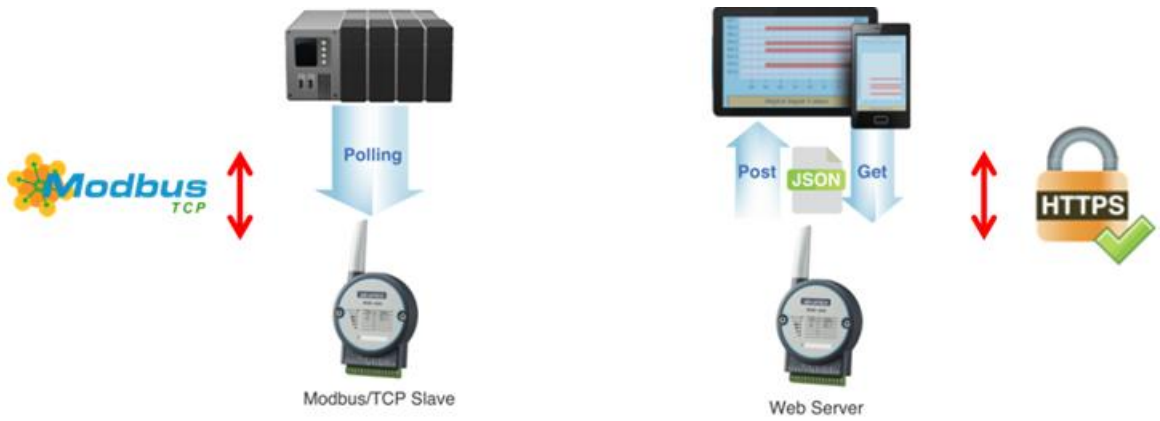

Figure 3: Automation Protocol vs. RESTful Web API

The WISE-4000 series provides three security steps to ensure the safety for IoT data.

1. Wi-Fi WPA2 Encryption: All the data via Wi-Fi will be encrypted during transmitting.
2. HTTPS Secure Socket: The protocol which is used for transmitting data uses this protocol, which and prevent eavesdropping and tampering.
3. User Authorized: User needs to login the webpage before configuration, the white list can also be set in web configuration to prevent unauthorized IP address.

Figure 4: Three steps of Security

When RESTful web services are combined with HTML 5, an embedded web page in APP can be used by every device with an HTML 5-compliant browser.

Advantech's WISE-4000 modules use RESTful web services and HTML 5. The new web configuration interface can automatically change its layout when used with different kinds of devices. For a mobile device that has a vertical screen, it will auto-layout to fit the screen of that mobile device. It will automatically switch to a horizontal layout when using a laptop or tablet.

Figure 5: Individual or Group Configuration Permits Fast Deployment and Diagnostics

Access to the configuration page for WISE modules is an authorization process. Users need to log in with the appropriate account for different authorizations, such as root, admin, or guest, which ensures the security of the module.

Cloud Data Management: Traditional v. Cloud Data Loggers – WISE Cloud Logger

Advantech is one of the premier data acquisition module manufacturers in the world, with more than thirty years of data acquisition experience. Traditional data loggers are connected to sensors, which develop the data. The data logger stores the data locally, until it is downloaded locally or over a wired or wireless network.

Compare this to the way a Cloud-based data logger system functions. Local storage of data is enabled, and may be polled by the user, as in a traditional framework, but the data may also be pushed to the Cloud automatically. Once the logger reaches the pre-set upload criteria, data is pushed to file-based Cloud storage like Dropbox. The data is saved on the cloud server in *.csv file format, which is the simplest and most transparent format for data. The user synchronizes the data on the Cloud using the standard application program available from the Cloud provider.

Using a mobile device, the data on the Cloud server can be accessed at anytime, anywhere, by anyone with the correct permissions. Using a RESTful API, the data can be pushed on demand or automatically to a private cloud server in the form of JSON (Javascript Object Notation). A user can set up their private cloud server by providing a RESTful API and their own platform. A Cloud-based logger provides a very flexible

solution for cloud data storage. Using the WISE module, there is only one step from data acquisition to the Cloud.

Other features include:

1. Reducing the concern of a wireless interface: The WISE modules focus on wireless connectivity. Even though a new generation of Wi-Fi interface could be stable, users are concerned that he wireless signal maybe reduced or nonexistent. In this situation, WISE modules provide local data storage. The I/O data and system events are logged in the internal flash memory of the WISE module. So now, users can fetch this logged data when communication is restored.

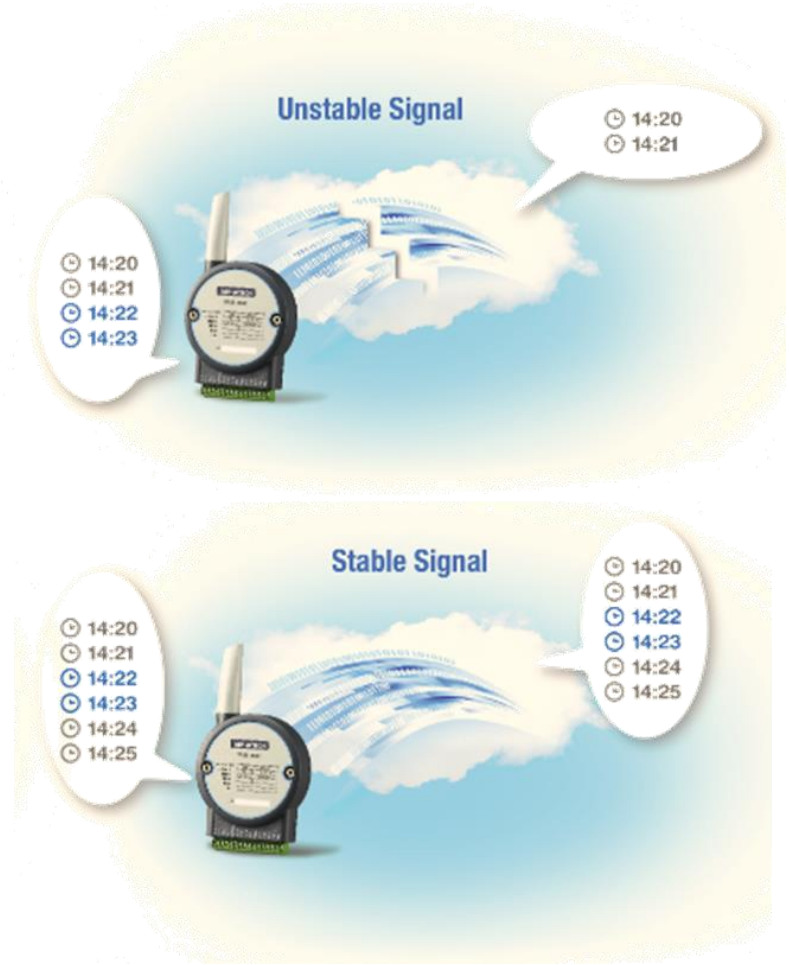

Figure 6: Stable/Unstable Signal Scenario

2. Reduce the communication time and bandwidth: In the IoT communication architecture, periodic polling takes lots of time and bandwidth. Once the data can be logged in the module, users can pull a batch of data as the same time, instead of polling each piece of data individually. In this case, a user can simplify the polling mechanism and also reduce the communication interface fee.

Figure 7: Batch Transmission

3. Data storage with time stamp: The definition of data in the IoT is not only the status of everything but also includes time or location information. With a built-in real-time clock (RTC), the WISE modules log data with a time stamp and the MAC address of the WISE module. The internal RTC can be calibrated by SNTP with time server. Once the module has been powered- up, the internal time can also be saved by using the time backup battery. When users poll the data from the data logger, the time stamp will always be attached to the data.

Figure 8: Data with Time Stamp

4. Up to 1,000 samples local data storage: The internal flash of the WISE module can log up to 10,000 samples of data with a time stamp. The I/O data can be logged periodically, and also when the I/O status changes. Once the memory is full, users can choose to overwrite the old data to ring log or just top the log function. When the module is powered-off, data can be kept in the module. When restarting, users can decide whether to clear all data or continue logging.

Figure 9: Local Data Storage with 10,000 samples

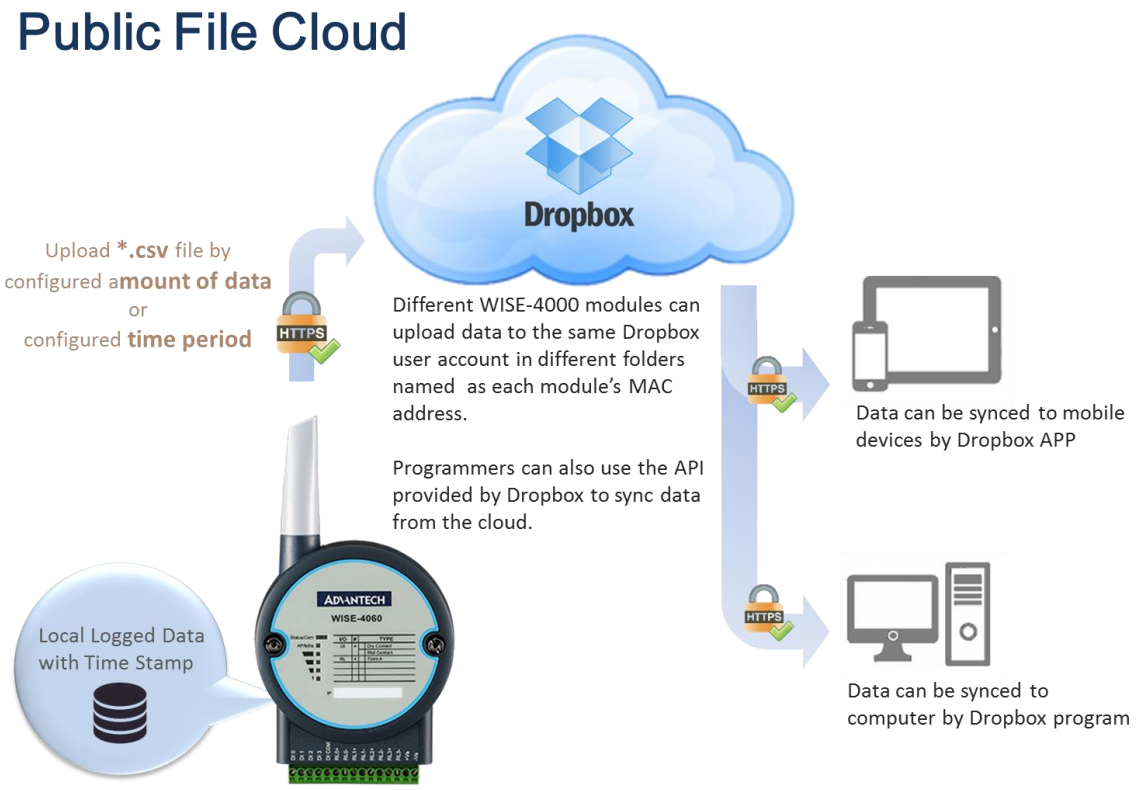

Figure 10: Mechanism of Data Publishing

Using browser-based HMI/SCADA software, such as the Advantech WebAccess 8.0, which is capable of running on any device from smart phones to desktop OS, a complete Cloud-based HMI and Supervisory Control and Data Acquisition system can be designed and constructed using WISE-4000 and other Advantech data acquisition devices, as well as open data connectivity using industrial protocol and ODBC integration. WebAccess provides three kinds of interfaces. First, WebAccess provides a Web Service Interface for

partners to integrate data into their own apps. Second, a pluggable widget interface has been opened for programmers to develop their own widgets to run on the WebAccess Dashboard. Finally, WebAccess includes a DLL interface for developing Windows applications. WebAccess can act as an IoT platform to permit development of IoT applications in different vertical markets.

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